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Linear Body Anthropometry of Yorubas of Southern Nigeria

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ABSTRACT

The attendant overcrowding in dissecting rooms and difficulty in procurement and preservation of cadavers, variations present in cadaveric specimen and the need to learn layout to recreate common surgical operations were the reasons for which the concept of anatomical modeling was opted for. The aim of this study was to investigate the linear body anthropometry of Yorubas of southern Nigeria for future reconstruction of three-dimensional negroid gross anatomical model. The research adopted a non-experimental, cross-sectional design. A total number of four hundred (400) subjects whose ages ranged between 21 to 40 years with BMI of 18.50 to <30.00 were used. The Taro Yamane's formula was used to derive the minimum sample size. BMI and linear body anthropometric measurements were taken using standiometer, calibrated flexible meter tape and weighting scale. Statistical analysis was done using statistical package for the social science (SPSS version 25.0) and Microsoft Excel 2019. Continuous variables were presented as mean±SD; minimum and maximum. Age was categorized into two groups (21 – 30 and 31 – 40) years while Body Mass Index (BMI) was also categorized into two; normal weight (18.5 – 24.9 designated $\leq$ 25.0) and slightly overweight (25.0 – 30.7 designated $\geq$ 25.0). Independent sample t-test was therefore carried out to determine significant difference in the measured anthropometric variables across age and BMI groups. The confidence interval was set at 95%, therefore $p < 0.05$ was considered significant. Results were presented in tables. Age related changes and variations in BMI were also observed in the anthropometric parameters. These anthropometric values will find use in the standardization of negroid gross anatomical models for medical studies and forensics.

Key Words: Linear, Whole body, Gross, Anatomical Modelling, Yoruba, Negroid

INTRODUCTION

Anthropology involves the study of the physical variation of man and relies on external measurements of the human body particularly the skeleton, for description, analysis and classification of fossils and human populations. Although human anatomy describes the structure of the body as observed in most people and has traditional value in surgery, there exists a wide range of ethnic and racial variation in the physical appearance and body proportions of different populations[1]. Existence of this variation which is present in cadaveric specimen coupled with the attendant overcrowding in dissecting rooms and difficulty in procurement and preservation of cadavers, and the need to learn layout to recreate common surgical operations were the reasons for which the concept of anatomical modeling was opted for[2]. Anthropometric studies are therefore carried out along the lines of these variations. Anthropometric measurements have been adopted as methods in clinical and public health works, as they are applicable to large samples and can provide national estimates and data for the analysis of secular changes[3]. It therefore becomes necessary to generate data that would enable the standardization of anatomical models using negroid specific values.

MATERIALS AND METHODS

Research Design: The research design was analytical (non-experimental) design which catalogued values of the linear anthropometric body features of adult male Yorubas of southern Nigerian using anthropometric standards for the reconstruction of a three – dimensional negroid gross anatomical modelling.

Sample Size and Sampling Technique: Subjects were randomly selected from amongst adult male Yorubas resident in Akure, Idanre, Akoko and Okitipupa in Ondo State. A total number of four hundred (400) adult males were used for the study. The minimum sample size was determined using the Taro Yamane's formula which states that:

$$n = \frac{N}{1+N(e)^2}$$ where n = minimum sample size, N = population size, e = error margin = 0.05

Only adult males between the ages of 21 and 40 years with BMI of 18.50 to <30.00 were included in this study. It was ascertained that recruited subjects had both parents and four grand parents from the same ethnic group.

Exclusion criteria included factors that might affect the outcome of the measurements.

Ethical Considerations: Ethical clearance was sought and obtained from the Ethics Committee of the College of Health Sciences, University of Port Harcourt. Informed consent was obtained from all subjects.

Method: The study utilized measurement of some selected linear body anthropometric variables. The following linear measurements were taken using appropriate landmarks such as standing height, sitting height, arm span, biacromial breadth, arm length elbow breadth, wrist breadth, biiliac breadth, thigh length , knee height and foot length.

Statistical Analysis: Statistical analysis was done using statistical package for the social science (SPSS version 25.0) and Microsoft Excel 2019. Continuous variables were presented as mean±SD; minimum and maximum. Age was categorized into two groups (21 – 30 and 31 – 40) years while Body Mass Index (BMI) was also categorized into two; normal weight (18.5 – 24.9 designated $\leq$ 25.0) and slightly overweight (25.0 – 30.7 designated $\geq$ 25.0). Independent sample t-test was therefore carried to determine significant difference in the measured anthropometric parameters according to age. The confidence interval was set at 95%, therefore $p< 0.05$ was considered significant.

RESULTS

Table 1: Descriptive statistics of the measured Linear Body Parameters (cm)

Linear Body Parameters	[N = 400]		
	Mean ± SD	Min	Max
BMI (Kg/m^2)	22.70±3.47	18.60	30.90
Age (years)	26.04±4.96	21.00	40.00
Standing Height	175.23±7.18	162.70	190.24
Sitting Height	84.12±4.75	73.80	91.00
Arm Span	180.33±10.85	153.23	192.44
Bi-acromial Breadth	38.48±4.10	32.10	45.90
Upper Limb Length	78.15±6.48	62.40	89.92
Elbow Breadth	7.43±1.61	5.10	10.80
Wrist Breadth	5.80±0.99	4.11	7.91
Bi-iliac Breadth	29.59±2.59	24.10	31.96
Thigh Length	50.08±6.28	43.80	60.40
Knee Height	50.17±3.91	44.30	55.64
Foot Length	27.95±1.64	23.00	31.70

SD = Standard deviation, Min = Minimum, Max = Maximum

Table 1 shows descriptive statistics of the measured linear body parameters of Yorubas in cm. Mean standing height was 175.23±7.18, sitting height (84.12±4.75), arm span (180.33±10.85), bi-acromial breath (38.48±4.10), upper limb length (78.15±6.48), elbow breadth (7.43±1.61), wrist breadth (5.80±0.99), bi-iliac breadth (29.59±2.59), thigh length (50.08±6.28), knee height (50.17±3.91) and foot length (27.95±1.64).

Table 2: Descriptive statistics of the measured linear body parameters according to age

Linear Body Parameters	Age group	N	Mean	SD	*t*-test			
					Df	*t*-value	*p*-value	Inference
BMI (Kg/m^2)	21 - 30	327	22.75	3.46	398.00	0.59	0.56	Not Significant
	31 - 40	73	22.49	3.51				
Standing Height	21 - 30	327	175.20	7.18	398.00	-0.16	0.87	Not Significant
	31 - 40	73	175.35	7.20				
Sitting Height	21 - 30	327	84.04	4.79	398.00	-0.68	0.50	Not Significant
	31 - 40	73	84.46	4.61				
Arm Span	21 - 30	327	180.09	10.81	398.00	-0.92	0.36	Not Significant
	31 - 40	73	180.38	11.08				
Bi-acromial Breadth	21 - 30	327	38.31	4.08	398.00	-1.77	0.08	Significant
	31 - 40	73	39.25	4.13				
Upper Limb Length	21 - 30	327	78.02	6.70	126.50	-0.95	0.34	Not Significant
	31 - 40	73	78.72	5.41				
Elbow Breadth	21 - 30	327	7.46	1.61	398.00	0.59	0.56	Not Significant
	31 - 40	73	7.33	1.58				
Wrist Breadth	21 - 30	327	5.78	0.98	398.00	-0.86	0.39	Not Significant
	31 - 40	73	5.89	1.04				
Bi-iliac Breadth	21 - 30	327	29.65	2.62	398.00	1.00	0.32	Not Significant
	31 - 40	73	29.32	2.46				
Thigh Length	21 - 30	327	49.25	6.42	118.50	1.26	0.21	Not Significant
	31 - 40	73	48.31	5.58				
Knee Height	21 - 30	327	50.29	3.99	116.43	1.43	0.16	Not Significant
	31 - 40	73	49.62	3.54				
Foot Length	21 - 30	327	27.93	1.63	398.00	-0.47	0.64	Not Significant
	31 - 40	73	28.03	1.66				

Table 2 shows the descriptive statistics of the measured linear body parameters according to age Yoruba subjects. Mean Standing Height for age group 21 – 30 was 175.35±5.88 while that of age group 31 – 40 was 173.16±4.39. Mean Sitting Height for age group 21 – 30 was 80.56±3.77 while that of age group 31 – 40 was 80.71±4.33. Arm Span for age grade 21 – 30 (179.73±9.66) whereas for age group 31 – 40 was 179.98±8.84. Bi-acromial Breadth for age group 21 – 30 was 38.69±3.89 while for age group 31 – 40 was 37.60±4.13. Upper Limb Length for age group 21 – 30 was 76.74±7.21 while that of age group 31 – 40 was 76.29±7.99. Mean Elbow Breadth for age group 21 – 30 was 8.20±1.25 while that of age group 31 – 40 was 7.42±1.46. Wrist Breadth for age group 21 – 30 was 5.97±0.88 while that of age group 31 – 40 was 6.03±0.84. Bi-iliac Breadth for age grade 21 – 30 (28.11±2.07) whereas for age group 31 – 40 was 28.04±2.31. Thigh Length for age group 21 – 30 was 48.70±6.02 while for age group 31 – 40 was 49.03±6.62. Knee Height for age group 21 – 30 was 49.56±3.53 while that of age group 31 – 40 was 48.03±3.70. Foot Length for age group 21 – 30 was 26.24±1.41 while that of age group 31 – 40 was 26.24±1.32. Independent sample t-test shows that Bi-acromial Breadth and Elbow Breadth on comparison between the age groups were statistically significant ($\rho<0.05$) while the others showed no statistically significant difference ($\rho>0.05$).

Table 3: Descriptive statistics of the measured linear body parameters according to BMI

Linear Body Parameters	BMI	N	Mean	SD	*t*-test			
					df	*t*-value	*p*-value	Inference
Age (years)	Normal weight	308	26.11	4.96	398.00	0.48	0.63	Not Significant
	Slightly overweight	92	25.83	4.96				
Standing Height	Normal weight	308	180.45	7.22	398.00	1.13	0.26	Not Significant
	Slightly overweight	92	179.49	7.02				
Sitting Height	Normal weight	308	84.38	4.81	398.00	2.02	0.04	Significant
	Slightly overweight	92	83.24	4.47				
Arm Span	Normal weight	308	177.32	11.09	398.00	-0.04	0.97	Not Significant
	Slightly overweight	92	177.37	10.09				
Bi-acromial Breadth	Normal weight	308	38.81	3.88	131.92	2.69	0.01	Significant
	Slightly overweight	92	37.38	4.61				
Upper Limb Length	Normal weight	308	77.74	5.97	398.00	-2.35	0.02	Significant
	Slightly overweight	92	79.53	7.85				
Elbow Breadth	Normal weight	308	7.39	1.50	125.68	-0.95	0.34	Not Significant
	Slightly overweight	92	7.59	1.93				
Wrist Breadth	Normal weight	308	5.84	1.00	398.00	1.54	0.12	Not Significant
	Slightly overweight	92	5.66	0.92				
Bi-iliac Breadth	Normal weight	308	27.75	2.55	398.00	2.23	0.03	Significant
	Slightly overweight	92	27.06	2.68				
Thigh Length	Normal weight	308	49.04	6.34	398.00	-0.20	0.84	Not Significant
	Slightly overweight	92	49.19	6.10				
Knee Height	Normal weight	308	49.50	3.95	398.00	3.11	0.00	Significant
	Slightly overweight	92	48.07	3.58				
Foot Length	Normal weight	308	27.89	1.64	398.00	-1.35	0.18	Not Significant
	Slightly overweight	92	28.15	1.60				

Table 3 shows the descriptive statistics of the measured linear body parameters according to BMI in Yoruba subjects. Sitting Height, bi-acromial breadth, upper limb length, bi-iliac breadth and knee height showed statistically significant difference ($\rho<0.05$). No statistically significant difference ($\rho>0.05$) was observed in the other variables across BMI groups.

DISCUSSION

Mean standing height (175.23±7.18) in the present study was lower than those reported in Kosovo (178.79±6.07)[4], Bosnia and Herzegovina (183.9)[5], and Macedonia (178.10 ± 6.79)[5] but higher than that reported in India (165.96±6.33)[6]. Sitting height was (84.12±4.75) was lower than that of the Kosovans (96.07±3.51)[4].

The arm span (180.33±10.85) was higher than those of Indians (166.40±7.20)[6] and Macedonians (178.78 ± 7.71)[5]. Bi-acromial breadth (38.48±4.10) in the present study was higher than that reported for the Turks (386.06±23.09mm (38.606cm))[7] and slightly lower than the values obtained in a Turko-Mongolic population in Central Asia High Altitude Population (CAHAP); (39.9) mean bi-acromial breadth for all CAHAP, (39.5) High Altitude Kirghizs, (40.1) Mid Altitude Kazakhs, (40.7) Low Altitude Kirghizs and (39.0) Low Altitude Uighurs[8]. For the upper limb length, upper limb length (78.15±6.48) was higher than that reported in India (72.50±4.12)[9].

Elbow breadth (7.43±1.61) was higher than those obtained in the Turko-Mongolic population; 71mm (7.1cm) mean elbow breadth for all CAHAP, 70mm (7.0cm) High Altitude Kirghizs, 71mm (7.1cm) Mid Altitude Kazakhs, 71mm (7.1cm) Low Altitude Kirghizs and 71mm (7.1cm) Low Altitude Uighurs[8]. Wrist breadth (5.80±0.99) was higher than that of Turks (4.98±2.84)[10].

Bi-iliac breadth (29.59±2.59) was higher than that of the Turks (28.92±25.94)[7]. Knee height (50.17±3.91) was higher than that of the Kori (42.42±4.25)[9] and lower than that reported for Caucasian Australians (51.1± 3.6)[11].

Foot length (27.95±1.64) was higher than that reported for a northern Indian population (20.22±1.90)[6] and the Kori population (25.26±1.2). Age[12] and BMI were observed to have significant impact on some of these variables.

CONCLUSION

Values obtained from linear body dimensions investigated in this study varied greatly in comparison with those of other populations. This variation could be as a result of nutritional, geographical or other factors. The values will be useful in the design of anatomical models specific for a negroid population. It will also find use in forensic science.

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